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NO DRAWINGS.

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COMPLETE SPECIFICATION.

Sealing.

We, ARMOUR AND COMPANY, a Corporation organised under the laws of the State of Delaware, United States of America, of 401 North Wabash Avenue, Chicago, Illinois 60611, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the heat sealing of inert plastic structures such as polyfluorocarbon or polyester film, as well as metal structures such as aluminium foil, and more particularly to a novel adhesive composition for a novel method of applying said composition to, and a novel heat seal for inert plastic or metal, particularly polyfluorocarbon and polyester sheet, film, web or like structure.

The exceptional qualities of polyfluorocarbon and polyester plastics are well known. These plastics make exceptionally good packaging webs. The webs are strong, nonflammable, inert, boilable, selectively vapour permeable, have good slip, good clarity, good flexibility and have Food and Drug acceptance.

The inertness of each plastic has, however, retarded market acceptance as a packaging film because of the difficulty of adhering the plastic to itself or to other materials. Indeed, this is acknowledged in *Modern Plastics Encyclopedia*, September, 1964, McGraw Hill, Inc., New York, page 734, wherein it is stated that polyfluorocarbon plastics may only be bonded to themselves and other materials if pretreated or etched. Although several methods for applying a heat seal coating have been devised, none have been completely satisfactory.

One method has been to extrude a thin film of polyethylene onto the surface of the polyfluorocarbon, or polyester substrate. For example, if the substrate is film, the film may then be folded upon itself with the polyethylene surface on the inside. Then, when heat and pressure are applied to the edges, the polyethylene, but not the polyfluorocarbon or polyester substrate, melts and a pouch is formed. Such a polyethylene heat seal coat, however, is poorly adherable to the base, sometimes becoming a so-called "leaker" because the heat seal fails to provide a good bond, probably between the polyethylene and the substrate film even though both faces of polyethylene have been melted into one. The heat seal is also not sufficiently impervious to alcohols which frequently comprise a component of the packaged item such as food. Furthermore, the seal is not effective on or around powder or dust. This confines the laminate to the packaging of solids, such as tablets.

In addition to extruded polyethylene as the adhesive, other compositions, known as

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"hot melts" have also been used. But such usage has not met with complete commercial success because the hot melts are very viscous, and require very high heats during application. Also, their high viscosities force the use of thicker films than desired for economy reasons.

In the *Modern Plastics Encylopedia*, the use of epoxy adhesives for fluorocarbons is mentioned, but with the limitation that the "joint strength is only moderate". This is not satisfactory for certain sealing, such as in pouch making, and specifically boilable pouches where the drastic conditions encountered create havoc with the polyester seal.

It is an object of this invention to provide a novel adhesive composition for inert surfaces such as polyfluorocarbon plastics, polyester plastics and aluminum foil which is useful for package sealing. Other objects include the provision of a novel method for the application of the adhesive composition and the provision of a novel heat sealed polyfluorocarbon plastic structure.

It has now been found according to the invention, that inert web structures such as those of polyfluorocarbon plastics, polyester plastics and aluminium, may be adhered to other structures or to themselves by the use of a novel composition, certain components of which are normally used as a hot melt, but in this instance are dissolved in a solvent and applied simply as a solution which is then dried. Furthermore, it has also been found that the composition is surprisingly effective for adhering shrinkable plastic without loss of adhesion. The novel adhesive composition seems to shrink at the same rate, as the shrinkable plastic to which it is applied. This allows such shrinkable bags to be heat sealed into open pouches, filled with product, air evacuated, heat sealed at the open end, and lastly shrunk onto the product by application of heat (as by dipping into a hot liquid for a very short time).

The present invention provides an adhesive composition for adhering inert plastics and metals to themselves and to other plastics and metals comprising 20 to 100 parts by weight of a thermoplastic copolymer of vinyl acetate and ethylene, of vinyl acrylate and ethylene or of vinyl acetate and propylene, 5 to 80 parts by weight of an ester of pentaery-thritol or glycerol with one of the following acids that is a rosin, terpene, polyterpene or dimerized resin acid, together with 1 to 30 parts by weight of a wax and 100 to 400 parts by weight of a solvent. In one specific example of the adhesive composition the copolymer is a copolymer of vinyl acetate and ethylene, the ester is a rosin ester of pentaerythritol, the wax is paraffin wax and the solvent is toluene.

While the exact mechanism involved in attaining a successful heat-sealable bond, by use of adhesive of the invention is not understood, it is believed that a better wetting by the solvent probably occurs. Such improved wetting of and probably blending of the adhesive into the substrate results in a more positive bond to the inert substrate. This same hypothesis would appear to be equally applicable to shrinkable plastic wherein the improved wetting causes better adhesion of the hot melt composition onto the substrate. Since the composition is dissolved in a solvent, the substrate shrinkable film will not exceed the boiling point of the solvent so long as any solvent remains. Since relatively low boiling solvents are used the shrinkable film remains cool while the solvent is removed from the adhesive as the shrinkable film, adhesive and its solvent pass through a film treating tower whereas the shrinkable web would immediately shrink into a non-usable state for packages if one attempted to place a melted "hot melt" or "heat seal" directly on one of its surfaces.

The adhesive composition according to the invention comprises as indicated above:

20 to 100 parts, and preferably 40 parts, of a thermoplastic copolymer of vinyl acetate and ethylene, of vinyl acrylate and ethylene or of vinyl acetate and propylene, the copolymer have a molecular weight which will form a solution with cold or warm, but not hot, solvent;

5 to 80 parts, and preferably 40 parts, of an ester formed by the reaction of pentaerythritol or glycerol, with one of the following acids, that is rosin (including hydrogenerated rosin), terpene, polyterpene, and dimerized resin acids; and

1 to 30 parts, and preferably 20 parts, of a wax such as low melting (about 135°F) paraffin wax, or very low melting (about 120° to 130°F) microcrystalline wax;

admixed with

100 to 400 parts, and preferably 233 parts of a solvent such as the aliphatic or aromatic hydrocarbons such as heptane, hexane, octane, benzene, toluene, xylol and methyl ethyl ketone.

All the parts given above or elsewhere herein are parts by weight.

When the above composition is to be used on substrates which are to be used to form boilable pouches, it is preferred that the adhesive compositions contain a maximum amount of thermoplastic copolymer component e.g. 80 to 100 parts, a minimum amount of ester component e.g. 5 to 10 parts and a minimum amount of wax, e.g. 1 to 5 parts, but in each instance, falling within the concentration ranges above. This will insure a more permanent heat seal under

the drastic conditions encountered when the sealed pouch is inserted into boiling water. In forming such a pouch a boilable plastic film of proper dimension is selected and the adhesive is applied to the film which is then overlapped so that a pouch is formed the edges being subsequently heat sealed.

The substrate to which the above components may be applied may comprise films sheets, fabrics, webs or structures of the inert materials comprising polychlorotrifluoroethylene, polytetrafluoroethylene, polyvinylfluoride, polyvinylidenefluoride, polyethylene, polypropylene, polyamide, polyester and copolyester or the heat shrinkable materials comprising polyvinylidene chloride, polyvinylchloride, polyethylene, polypropylene and the more recent heat shrinkable polyesters and polyamides and also aluminium. steel, copper, brass and other metals.

The heat required to heat seal the above adhesive composition is generally 150 to 275°F with 180°F being the more customary heat necessary.

The pressure required to heat seal depends, to a large extent upon the adhesive compositions and the plastic substrate utilized, but in any event, ranges from 0.5 to 50 psi with 10 psi being preferred.

The following example illustrates the invention:—

EXAMPLE

A composition consisting of:

20 parts of vinyl acetate—ethylene copolymer such as Elwax 40 marketed by E.I. DuPont de Nemours of Wilmington, Delaware,

20 parts of a vinyl acetate—ethylene copolymer such as Elwax 220 marketed by E.I. DuPont de Nemours of Wilmington, Delaware,

40 parts of an ester of pentaerythritol and hydrogenated rosin such as Pentalyn A marketed by Hercules Powder Co. of Wilmington, Delaware,

20 parts of a paraffin wax at 133 to 135°C such as Essowax marketed by Standard Oil Company of New Jersey,

is added to 233 parts of toluene and applied via an applicator roll to one face each of two sheets of polyfluorochloroalkyl plastic film, specifically, Aclar film, as manufactured by Allied Chemical Company of New York, New York. The sheets are then placed upon each other with the coated surfaces abutting each other. A heated platen having a heat of 150°F and pressure of 20 lbs. per square inch is then pressed upon three of the edges to form an open ended pouch. Then a vegetable item is inserted into the pouch and the fourth edge sealed by application of said platen.

The vegetable containing sealed pouch may be quick frozen for storage for an extended period and still be subsequently immersed in boiling water to heat the vegetable content without deleterious effect upon the heat seals or the plastic film. The product is extremely tasty because the vapour and flavour ingredients have been locked in.

WHAT WE CLAIM IS:—

1. An adhesive composition for adhering inert plastics and metals to themselves and to other plastics and metals comprising 20 to 100 parts by weight of a thermoplastic copolymer of vinyl acetate and ethylene, of vinyl acrylate and ethylene, or of vinyl acetate and propylene, 5 to 80 parts by weight of an ester of pentaerythritol or glycerol with one of the following acids that is, a rosin, terpene, polyterpene or dimerized resin acid, together with 1 to 30 parts by weight of a wax and 100 to 400 parts by weight of a solvent.

2. An adhesive composition as claimed in claim 1 comprising 40 parts by weight of the copolymer, 40 parts by weight of the ester, 20 parts by weight of the wax and 233 parts by weight of the solvent.

3. An adhesive composition as claimed in claim 2 comprising 40 parts by weight of a copolymer of vinyl acetate and ethylene, 40 parts by weight of an ester of pentaerythritol and hydrogenated rosin, 20 parts by weight of paraffin wax melting at 133 to 135°C. and 233 parts by weight of toluene.

4. An adhesive composition substantially as herein described with reference to the Example.

5. A method of heat sealing inert plastics and metals to themselves and to other plastics and metals comprising the steps of applying an adhesive composition as claimed in any of claims 1 to 4 to the inert plastic, drying said adhesive and subsequently heat sealing the coated plastic to another substrate.

6. A method as claimed in claim 5 in which the adhesive composition comprises a copolymer of vinyl acetate and ethylene, a hydrogenated rosin ester of pentaerythritol, paraffin wax and a solvent.

7. A method of sealing polyfluorocarbon film to itself and to other plastics and metal comprising the steps of dissolving in 100 to 400 parts by weight of toluene 20 to 100 parts by weight of a copolymer of vinyl acetate and ethylene, 5 to 80 parts by weight of an ester of pentaerythritol and hydrogenated rosin and 1 to 30 parts by weight of a low melting wax, then applying the resultant adhesive composition to said film, drying said adhesive and subsequently heat sealing the coated film to another substrate.

8. A method of sealing heat shrinkable polyester film to itself and to other plastics and metals comprising the steps of dissolv-

ing in 100 to 400 parts by weight of toluene 80 to 100 parts by weight of a copolymer of vinyl acetate and ethylene, 5 to 10 parts by weight of an ester of pentaerythritol and hydrogenated rosin and 1 to 5 parts by weight of a low melting wax, then applying the resultant adhesive composition to said film, drying said adhesive and subsequently heat sealing the coated film to another substrate.

9. A novel heat sealed bond between two structures of inert plastic comprising a dried composition which has been heat-activated consisting of 20 to 100 parts of a thermoplastic copolymer of vinyl acetate and ethylene, of vinyl acrylate and ethylene, or of vinyl acetate and propylene, 5 to 80 parts by weight of an ester formed by the reaction of pentaerythritol or glycerol, with one of the following acids, that is a rosin, terpene, polyterpene or dimerized resin acid, and 1 to 30 parts by weight of a wax.

10. A novel heat sealed bond between two structures of polyfluorocarbon plastic comprising a dried composition which has been heat-activated consisting of 40 parts by weight of a copolymer of vinyl acetate and ethylene, 40 parts by weight of an ester of pentaerythritol and hydrogenated rosin, and 20 parts by weight of paraffin wax melting at 133° to 135°C integral with two abutting surfaces of said polyfluorocarbon plastic.

11. A novel heat sealed bond between two structures of shrinkable polyester plastic comprising a dried, heat-activated composition consisting of 80 to 100 parts by weight of a copolymer of vinyl acetate and ethylene 5 to 10 parts by weight of an ester of pentaerythritol and hydrogenated rosin and 1 to 5 parts by weight of a low melting wax integral with two abutting surfaces of said shrinkable polyester plastic.

12. A method of making boilable plastic pouches from inert plastic comprising the steps of selecting boilable plastic film of proper dimension for forming the pouch, applying an adhesive composition as claimed in any of claims 1 to 4 to the film, overlapping the film so that a pouch is formed and subsequently heat sealing the edges thereof with heat and pressure to form a boilable plastic pouch.

13. A method of making boilable plastic pouches from inert plastic comprising the steps of selecting boilable plastic film of proper dimension for forming the pouch, dissolving in 100 to 400 parts by weight toluene 20 to 100 parts by weight of a copolymer of vinyl acetate and ethylene, 5 to 80 parts by weight of an ester of pentaerythritol and hydrogenated rosin and 1 to 30 parts by weight of a low melting wax, applying the resultant adhesive composition to the film, overlapping said film in such manner as to form a pouch and subsequently heat sealing the edges thereof with heat and pressure to form a boilable plastic pouch.

14. A method of making shrinkable plastic packages from shrinkable plastic film comprising the steps of selecting shrinkable plastic film of proper dimension for forming the package, applying the adhesive composition as claimed in any of claims 1 to 4 to the film, overlapping the film so that a package is formed and subsequently heat sealing the edges thereof with heat and pressure to form a shrinkable plastic package.

15. A method of making shrinkable plastic packages from shrinkable plastic film comprising the steps of selecting shrinkable plastic film of proper dimension for forming the package, dissolving in 100 to 400 parts by weight of toluene 80 to 100 parts by weight of a copolymer of vinyl acetate and ethylene, 5 to 10 parts by weight of an ester of pentaerythritol and hydrogenated rosin and 1 to 5 parts by weight of a low-melting wax, then applying the resultant adhesive composition to the film, overlapping the film in such a manner that a package is formed and subsequently heat sealing the edges thereof with heat and pressure to form a shrinkable plastic packet.

16. A heat sealed laminate comprising at least two layers of a polyfluorocarbon plastic sheet with an integral layer of 40 parts by weight of a copolymer of vinyl acetate and ethylene. 40 parts by weight of an ester of pentaerythritol and hydrogenated rosin, and 20 parts by weight of paraffin wax melting at 133 to 135°C.

17. A heat sealed laminate comprising at least two layers of polyester plastic sheet with an integral layer of 80 to 100 parts by weight of a copolymer of vinyl acetate and ethylene, 5 to 10 parts by weight of an ester of petaerythritol and hydrogenated rosin and 1 to 5 parts by weight of a low melting wax.

18. A method of making a boilable plastic pouch substantially as herein described with reference to the Example.

19. A plastic pouch as herein described with reference to the Example.

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